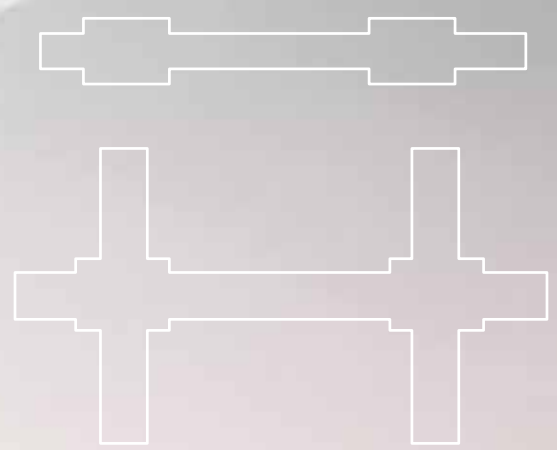


Wheels & Axles

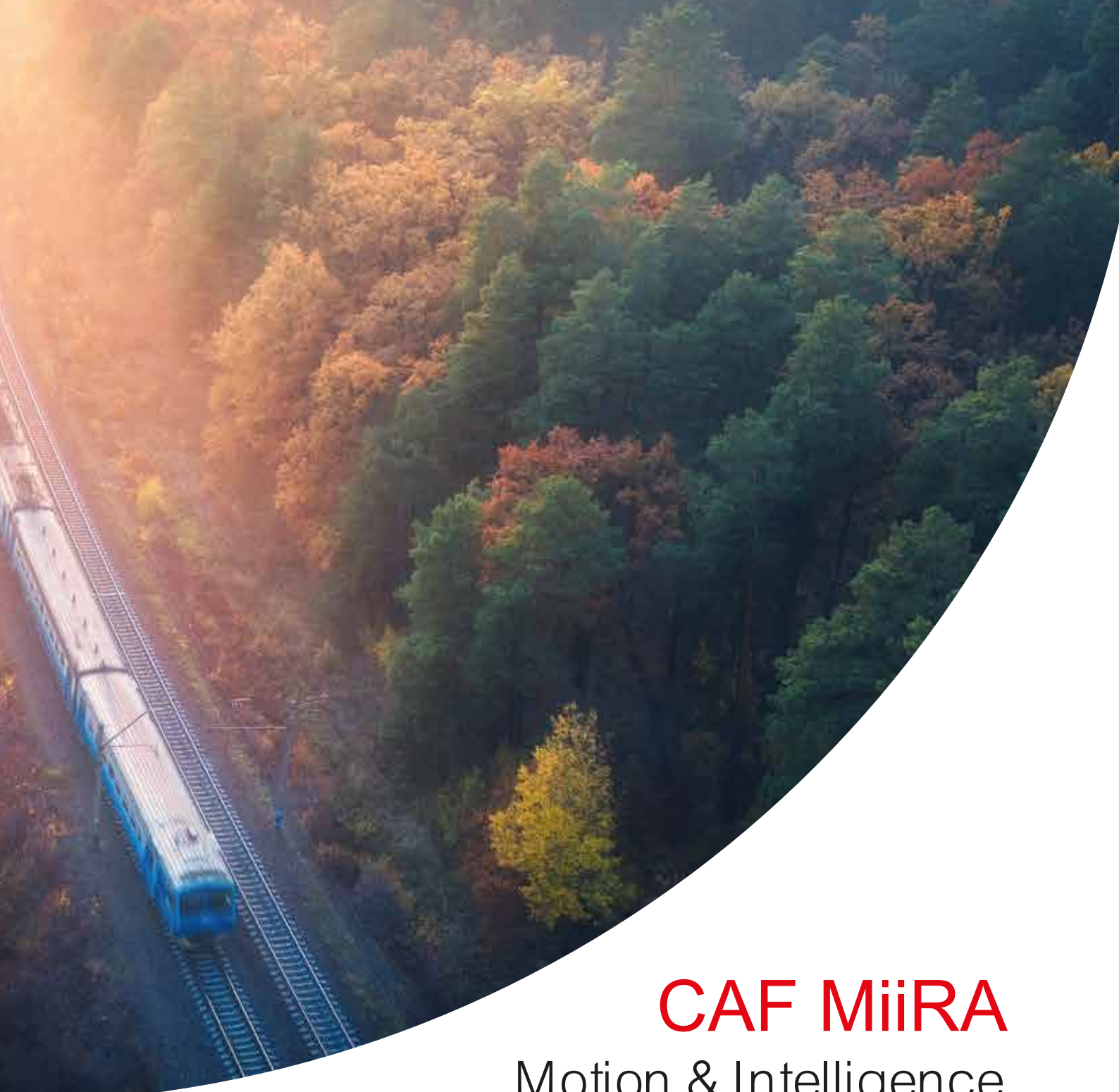
MiiRA | CAF
MOTION & INTELLIGENCE IN RAILWAYS





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CAF MiIRA

Motion & Intelligence in Railways

Almost a century of experience and state-of-the-art technology have made us world leaders in manufacturing railway wheels, axles, gearboxes, resilient wheels and complete wheelsets.



32/10t





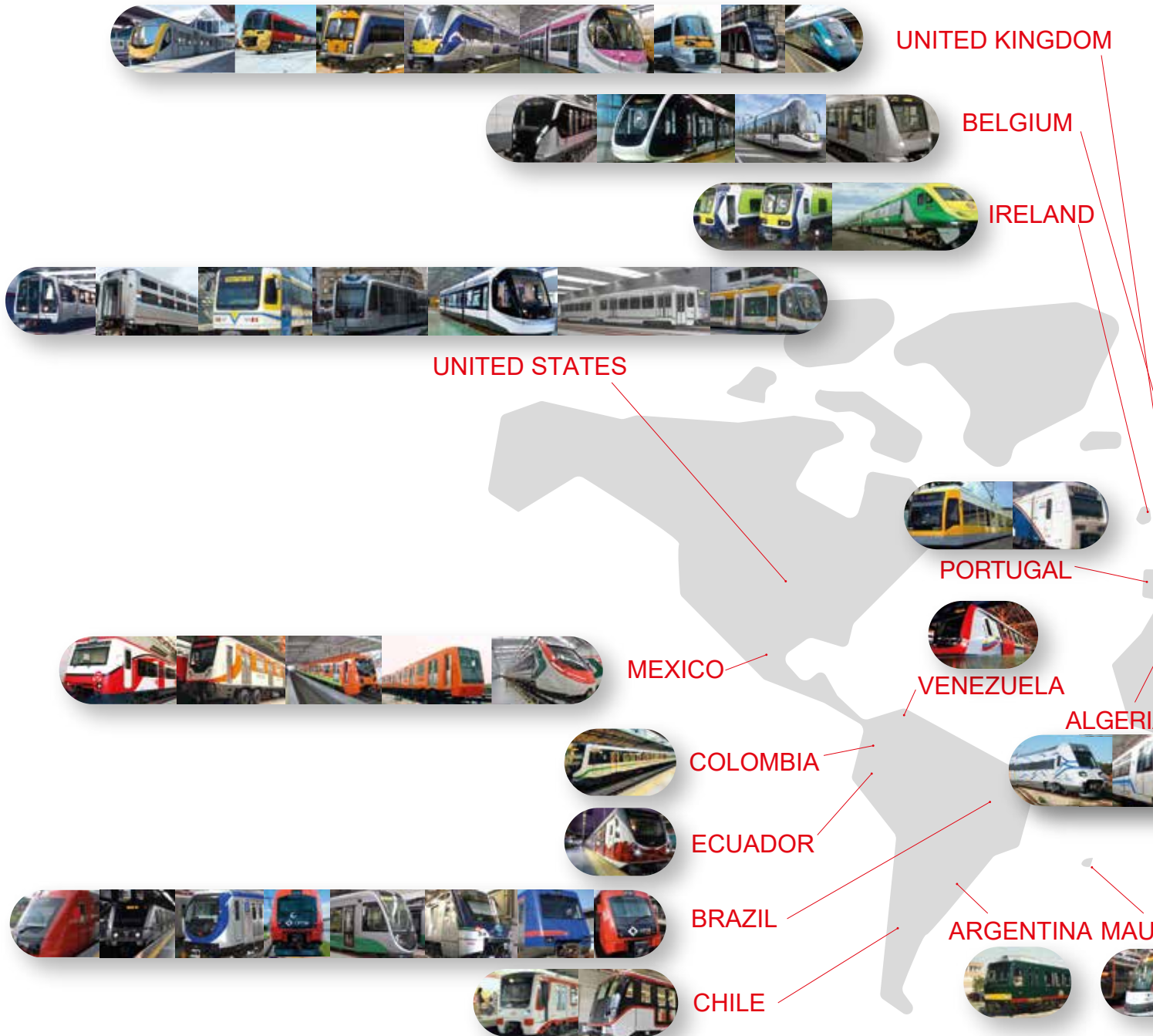
Multinational group with over 100 years of experience in the supply of comprehensive transit solutions positioned at the forefront of technology for high value added sustainable mobility.

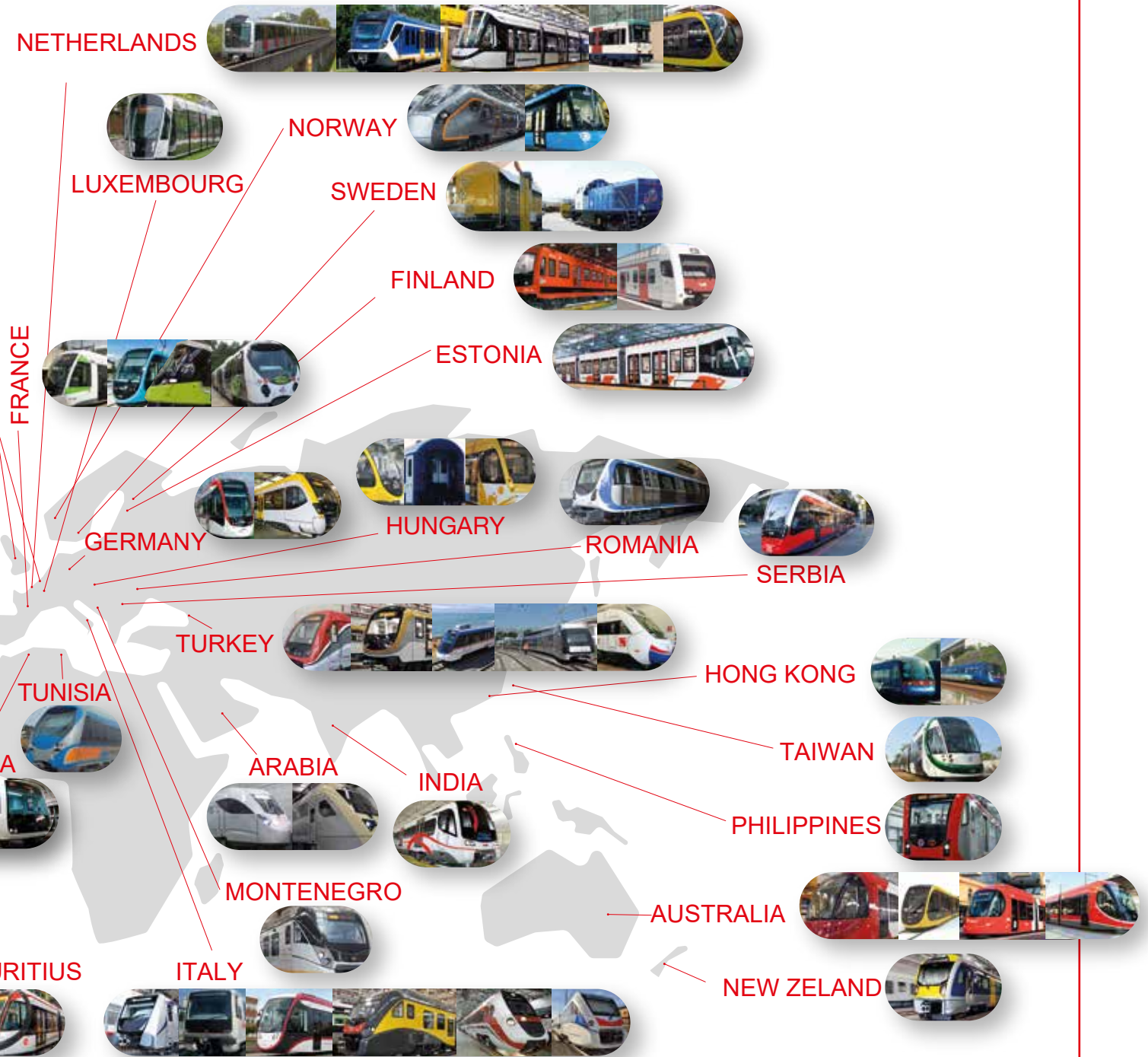


Over 70 subsidiaries



Worldwide projects





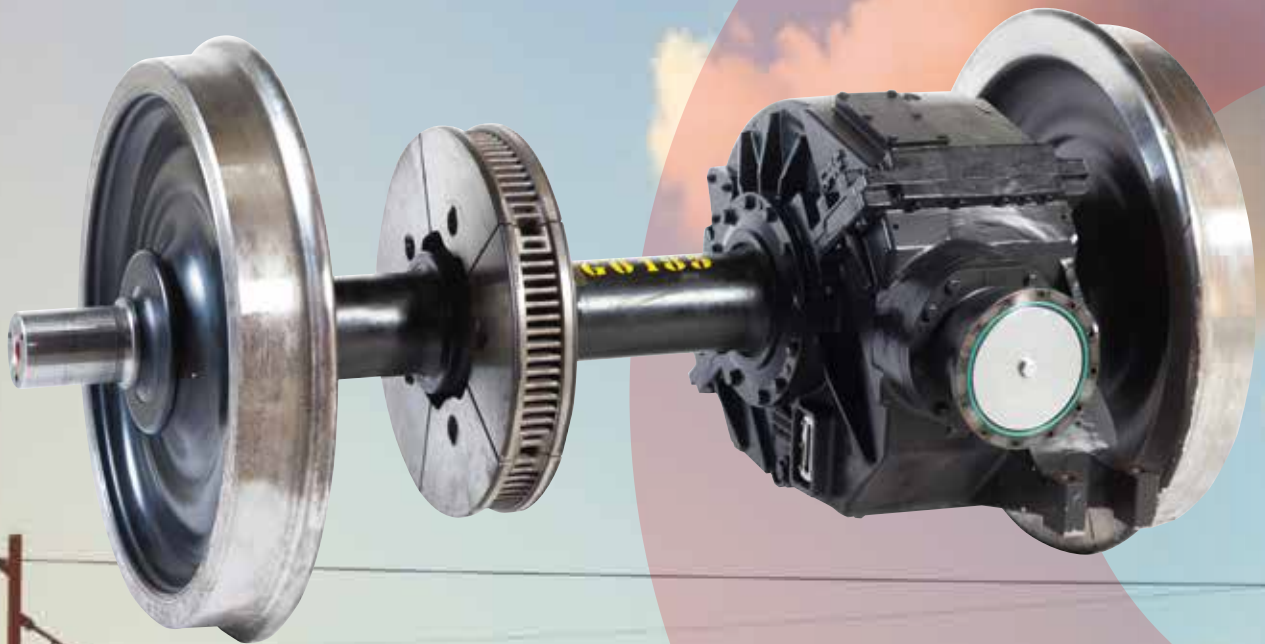
Industrial establishment in USA, France, UK, Mexico and Brazil

50 maintenance centers in the world

45-year concession to operate a system of suburban trains in Mexico City

Portfolio

Products & Services



ENGINEERING

Products' & materials' design

Modernizations

 ECO Design

SUPPLY

Products | Wheels
Axles
Wheelsets
Resilient wheels
Gearboxes

 Green Steel
 Green e-Energy

Value added elements | Protection systems
Noise reduction solutions

Integration on supply chain

 ECONsumption

SERVICE

 ECONmitted

Technological assessment | Maintenance plans' optimization
Failure analysis
Service inspections

Integral maintenance management

Life cycle optimization

 Circular ECONomy

Green future

Time for action



Green e-Energy

100% renewable certified e-Energy, produced by wind turbines.

Sustainable. Infinite.

Green Steel

Green Steel wheels and axles.

Our steel is below European Standards in terms of generated GHG intensity and below industry average.

Responsible. Green.

ECO design

More efficient designs that are lighter, require less maintenance and offer longer lifetimes.

Complete wheelset and gearbox designs that eliminate compatibility related problems, maximizing the reduction of total weight.

Efficient. Lightweight.

ECOconsumption

Lightweight designs that require less material and generate less waste.

Production and supply of complete wheelsets generate less carbon footprint: we avoid unnecessary operations and transports.

Integral. Clean.

Circular ECOconomy

100% of the scrap generated by our products is used to produce the steel we use. No additional external resources needed.

Reusable packaging system.

Recyclable.

ECOmmited

Part of SBTI ((Science based targets initiative) and Race to Zero, European initiatives against climate change aligned with the Paris Agreement.

Focus on continuous improvement to reduce carbon footprint throughout the entire life cycle of our products.

Endless improvement.

Certificates

Railways and Standard homologations

- ### CAF MiiRA Certifications
- ISO 14001
 - ISO 9001
 - OSHAS 18001
 - ISO-IEC-17025 certified metallurgical Laboratory
 - ISO / IEC 27001

- ### Railways Certifications
- IRIS
 - AAR
 - RISAS
 - GOST
 - VPI
 - RENFE (Spain)
 - SNCF (France)
 - DB (Germany)
 - OBB (Austria)
 - TRENITALIA (Italy)
 - SNCB (Belgium)
 - SBB (Switzerland)
 - CR (PRC)
 - NS (Netherlands)
 - Korail (South Korea)
 - MTR (Hong Kong)
 - MTA (USA)



Engineering

Design, Technological Assessment & Testing

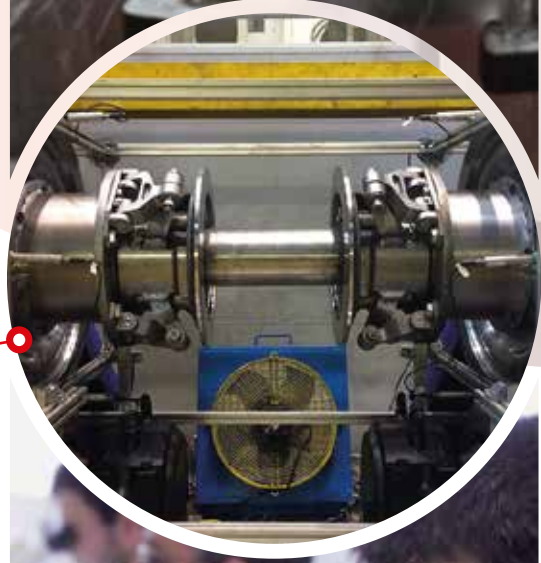
Design, validation and testing

CAF MiiRA has vast expertise in the design of wheels, axles and wheelsets. CAF MiiRA's products have been operating in main operators and OEMs since 1929.

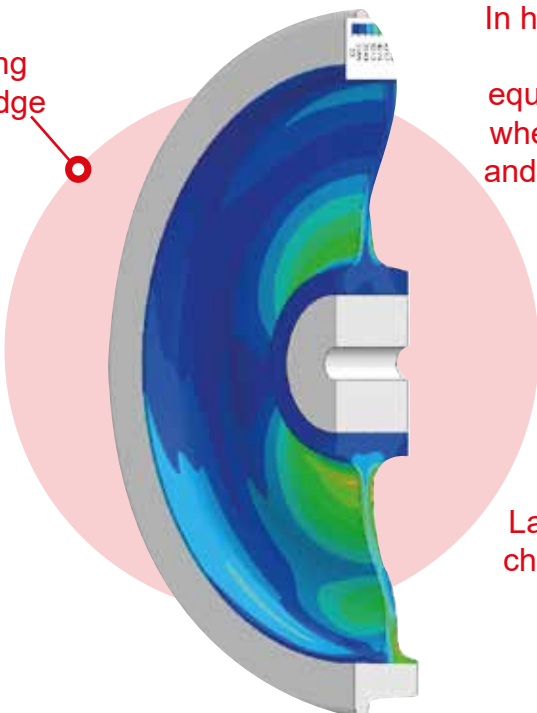
Heritage in Steel production for decades provides us superior expertise in wheels and axles metallurgy.

Modelling cutting edge tools enable product designs to be validated to ensure their safety, reliability and enduring operational performance.

Further to our modelling and metallurgy expertise, designs are validated and proven by physical testing which is done in CETEST, our ISO-IEC-17025 certified laboratory.



Modelling cutting edge tools



In house Type testing equipment for wheels, axles and wheelsets

Laboratory for characterization of steel



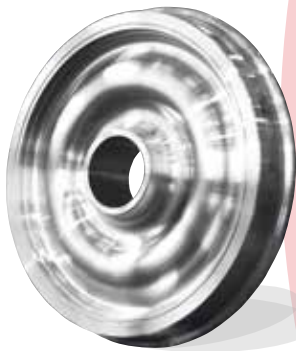
Technological Assessment

- **Analysis of requirements** and identification of customized solutions.
- **Assistance** in the definition and/or improvement of existing **designs**.
- Definition of specific materials and processes for each specific application.
- Engineering services for the analysis and **improvement of the performance** of the material in service.
- Definition of **maintenance operations**, including the development of NDT and inspection procedures.

Wheels

All types / Materials / Noise Reduction Solutions

- All type of forged wheels (from 550mm to 1.350mm).
- Produced in our state-of-the-art facilities.
- Comply with all Railways Standards: EN, AAR, RISAS, GOST, CR, JIS,...
- For all application in railway industry.



Low stress wheels

- Low stress ultra light monoblock wheels for high demanding freight applications developed by our top engineering team.



Locomotive wheel

- Worldwide reference in Locomotive monobloc wheels.
- Supplier for most demanding customers (operators and OEMs).
- Solutions for most demanding environments such as dessert.
- Deliveries to most demanding countries like US, China, Germany, Austria, Spain...



Auxiliary wheel

- Worldwide reference in auxiliary wheels for pneumatic metro cars.
- Large experience in Mexico DF metro lines, RATP metro, Marseille Metro, Montreal Metro...



Passenger Monoblock wheel

- Worldwide reference for highly demanding passenger wheels in terms of safety and performance.
- Supplier for main OEMs such as CAF, TALGO, CRRC, STADLER, ALSTOM, SIEMENS,...
- Operating in most challenging railroads all over the world for operators like RENFE, DB, OBB, SNCF, Trenitalia, CR, PR, MTA, RATP,...
- Successful experience collaborating and partnering with customers.



Noise Reduction Ring

- Cost-noise reduction high efficient ring solution
- Not welded
- Proven up to <250km/h EMU
- Own developed simulation program and own testing laboratory operating with great success in numerous fleets.



Wheel Centers

- Own design and production.
- Vast experience in the market.



Noise Reduction Plates

- Sandwich type solution for noise reduction applications.
- Oriented to >250km/h.
- Tested on own testing laboratory.
- Service proven under CAF and CRRC fleets.



Resilient Wheels

- Service proven thanks to the years of service in the most successful tram producers worldwide such as CAF, CRRC, Hitachi, Skoda, ...

Wheels

Rolling Stock steel grade solutions

XTRA LONG LASTING

Maximum hardness – extra life

An optimum combination of mechanical properties, maintaining high hardness levels even at the end of wheel operating life. Improved average service life accompanied by a reduction of maintenance operations such as the re-profiling. Life extensions under the most demanding operational conditions.

XTRA LOW FATIGUE

Maximum fatigue resistance (RCF)

Significant reduction of the damaged caused by rolling contact fatigue (RCF)
Delays the nucleation of fatigue cracks, obtaining important wheel life extensions.

ULTRA LOAD

Heavy haul

Applications with extreme axle loads (over 35 tons)
Preferred wheels for TTCI (AAR) laboratories in the USA (after analysis of 14 different manufacturer).
Ultra load steel grade increases wheel life and improves overall maintenance costs.

DESERT PROVEN

Optimised for desert zones - abrasion

Steel solution that under extreme service conditions on both freight and passenger, has shown an average wheel life increase exceeding 30%.
Reduces severe wear of the wheel due to the presence of sand in the wheel-rail contact.

COMPOPAD PROVEN

Optimised for tread braking

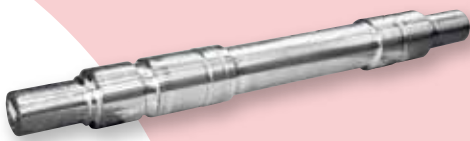
Specific ER7 grade (the main grade for wheels used for freight applications) which improves wear resistance and wheel performance under severe thermal cycles.
Evidence of improved performance and increased durability.



Axles

All types /
Cold-rolling /
Shot blasting

All kinds of driven and trailer axles



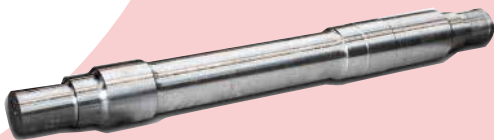
Finished axles

Completely finished axles for EMU, Metro, LRV and Locomotive fleets.



Hollow axles

Hollow axles allow much easier in-service inspections, cutting down the maintenance costs.



Cold rolled axles

Cold rolled axle, performed by our CNC line, can withstand much higher service loads without cracking.



Molibdenum coated axles

Molibdenum coating increases the lifetime of the axle, avoiding damages during wheels changing operations.

Facilities in Beasain, (Spain) and Milan, (Italy)

Completely automated cold-rolling line

We can treat the seats, the grooves or all the surface of the axle to:

- Increase the hardness on the surface and deep below.
- Introduce strong compressive residual stresses deep under the surface.
- Reduce the surface roughness.



Homologated shot blasting CNC machine

Our shot blasting process has been approved by main European operators. Using our shot blasting process we get several benefits:

- Clean the surfaces in depth.
- Increase the effective contact area between substrate and coating, drastically improving the adhesion.
- Increase the fatigue life, through the hardening and introduction of compressive residual stresses.



Class 1 coatings tested according to the EN 13261:

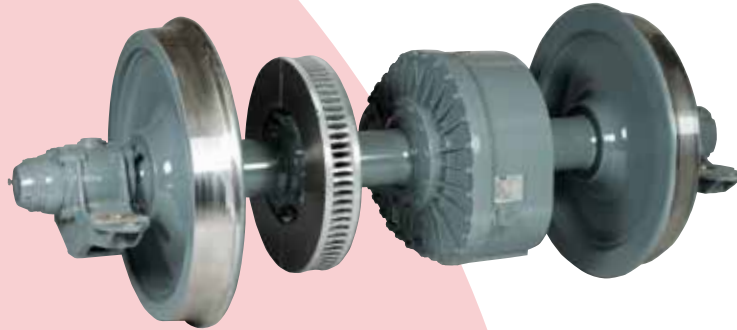
We have the capacity of applying in-house different types of class 1 coatings:

- We have service proven consolidated solutions that have shown an appropriate performance in the most demanding applications, also at subzero temperatures.
- Our references for class1 coated axles, include some of the most demanding customers such as DB and SNCF.



Wheelset

Complete life cycle



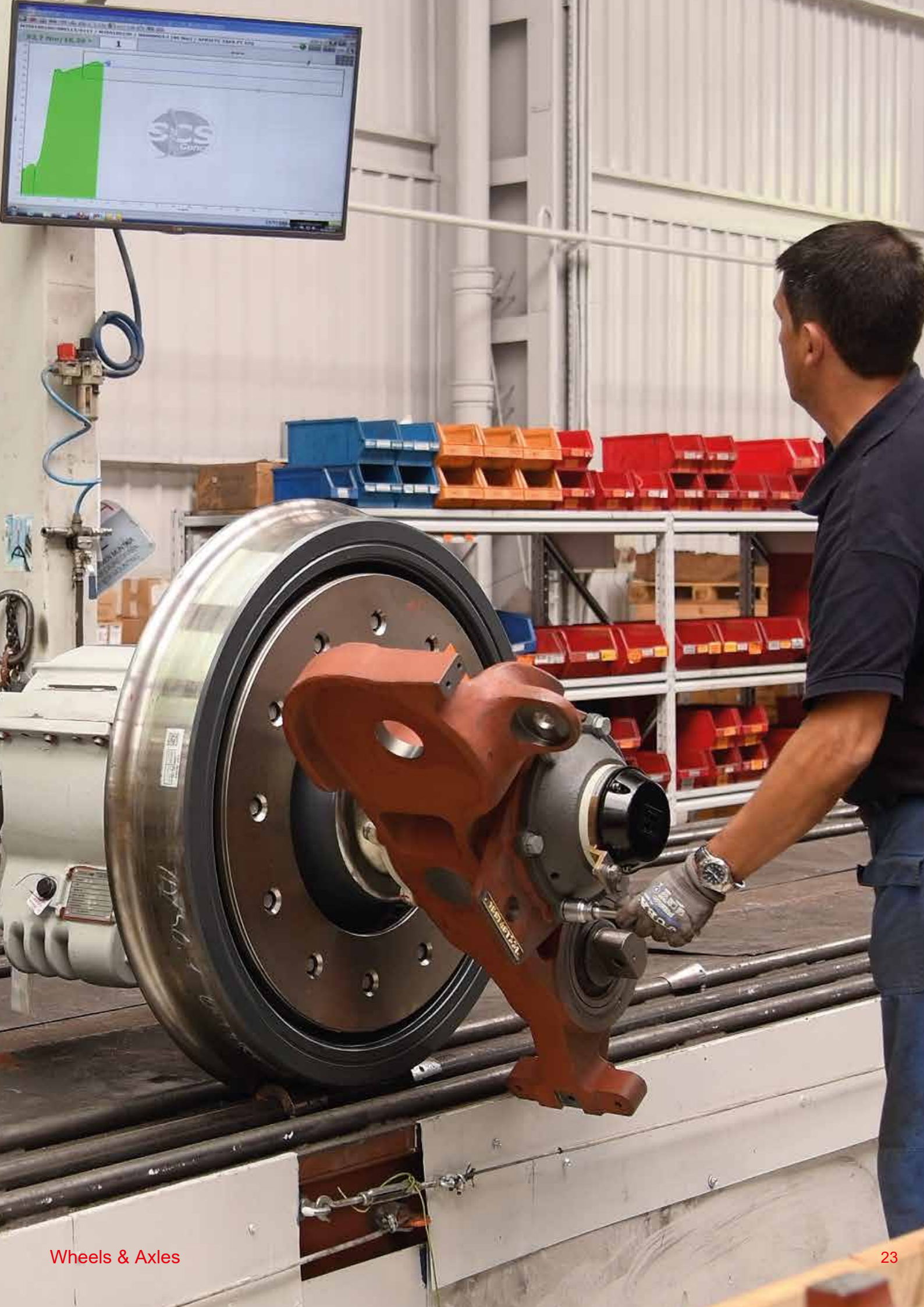
Complete wheelset design of all components including wheels, axles, gearboxes and axle boxes.

In house production and testing of all the components.

Integral Maintenance of Complete Wheelsets for wagons (IS1, IS2 or IS3) and passenger cars.

- Design of specific maintenance plans together with the final customer.
- Execution of the maintenance services.
- Supply of spare components.





References

Satisfied clients

- Freight loco operator



SAR

EMD Dessert

Supply of dessert locos wheels



Progress Rail

loco Fleet

Supply of wheels for different loco's of their fleet



DB

loco Fleet

Supply of wheels & axes for different loco's of their fleet



◦ Freight wagon operator



Transfesa
wagon fleet

Supply of complete wheelsets including
maintenances services for different
Wagon's of their fleet



HUPAC
wagon fleet

Supply of wheels including
maintenances services for different
Wagon's of their fleet



SAR
dessert wagon

Supply of wheelsets with
CAF MiiRA's wheels



◦ Freight loco OEM



CAF BITRAC Platform

Supply of complete wheelsets
with CAF MiiRA's wheels and axles



CRRC HXD2 Platform

Supply of loco's wheels



EKZ-Alstom KZ8 Platform

Supply of wheels & axles for different
loco's of their fleet




◦ Passenger loco OEM



CAF
Sar Push-Pull
Supply of complete wheelsets with CAF MiIRA's wheels, axles and gearboxes



CRRC Zhuzhou
HXD1D
Supply of wheelsets with CAF MiIRA's wheels



Bombardier-Alstom
TRAXX Platform
Supply of wheels and axles

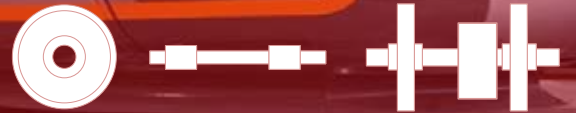


◦ High speed and intercity



CAF
OARIS Platform Flytoget

Supply of complete wheelsets with CAF MiiRA's wheels, axles and gearboxes



CRRC
Changchung

Supply of wheelsets with CAF MiiRA's wheels and axles



Talgo
AVRIL II Platform - Renfe

Supply of CAF MiiRA's wheels and axles

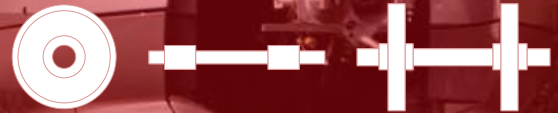


◦ Commuter and regional trains



Bombardier-
Alstom PhD - SNCF

Supply of wheelsets with
CAF MiiRA's wheels and axles



CAF
CIVITY Platform - NS

Supply of complete wheelsets with
CAF MiiRA's wheels,
axles and gearboxes



OBB
Railjet

Supply of CAF MiiRA's wheels and axles



◦ Metro



MTR
HONGKONG
Metro Operator

Supply of CAF MiiRA's wheels



CAF
STC Mexico Metro

Supply of CAF MiiRA's
auxiliary wheels and gearboxes



MTA
New York Metro Operator

Supply of CAF MiiRA's wheels and axles



◦ Trams



SKODA Eskisehir

Supply of CAF MiIRA's resilient wheels



CAF Freiburg

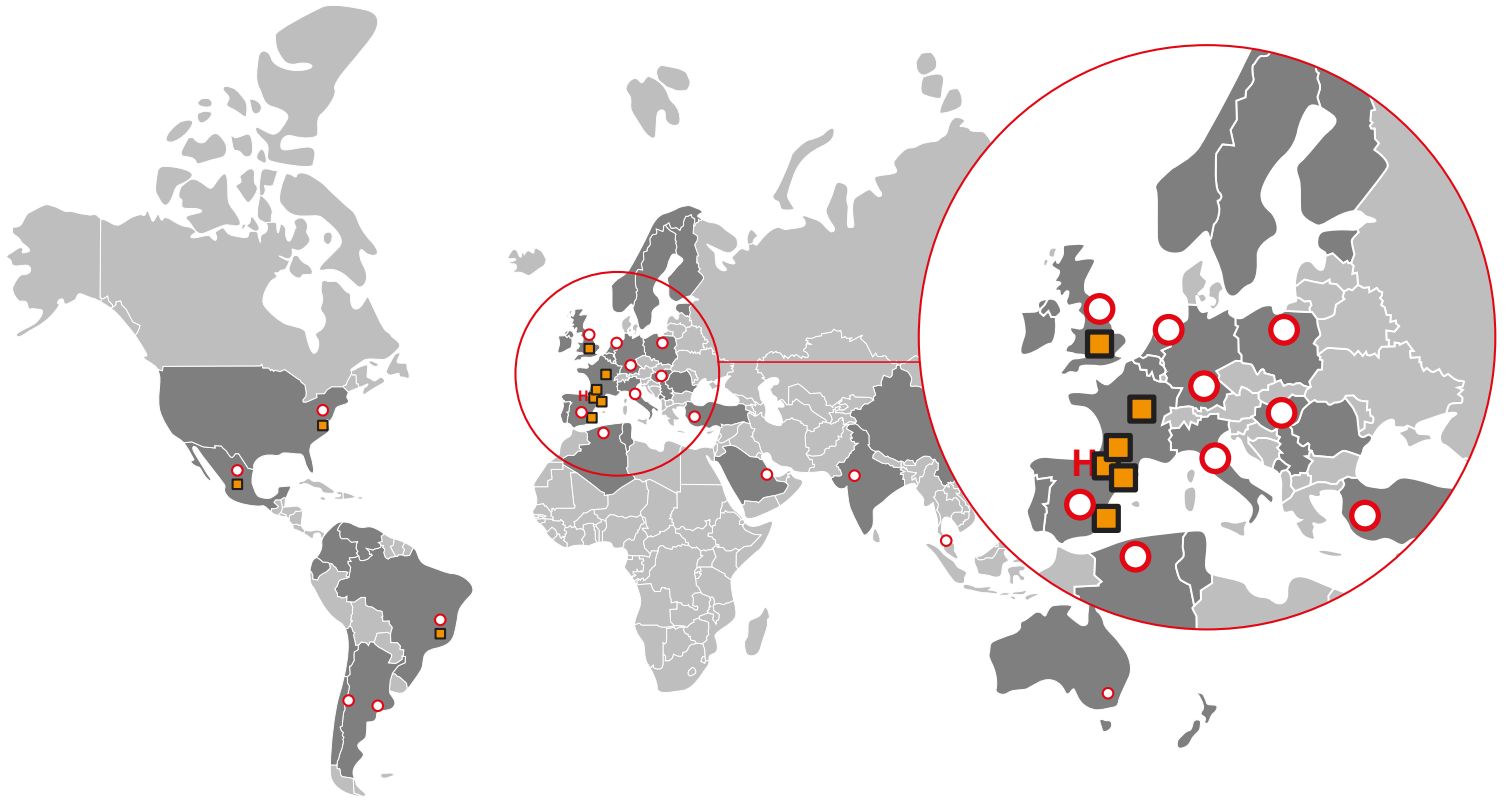
Supply of complete motor wheelsets
with CAF MiIRA's resilient
wheels and gearboxes



HITACHI Honolulu

Supply of CAF MiIRA's resilient wheels





- H** | Headquarters
- | Production Plants
- | Offices
- | Countries with ongoing projects

Headquarters:

- SPAIN

Production Sites:

- SPAIN • FRANCE
- USA • BRAZIL
- MEXICO • UK

Subsidiaries:

- MADRID • PARIS • LONDON
- MUNICH • WASHINGTON D.C.
- NEW DELHI • MEXICO D.F.
- ROME • SYDNEY • WARSAW
- SAO PAULO • BUENOS AIRES
- ISTANBUL • ROTTERDAM
- DOHA • KUALA LUMPUR
- SANTIAGO DE CHILE
- BUDAPEST



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